Deep learning-based system paves the way for efficient battery health assessment

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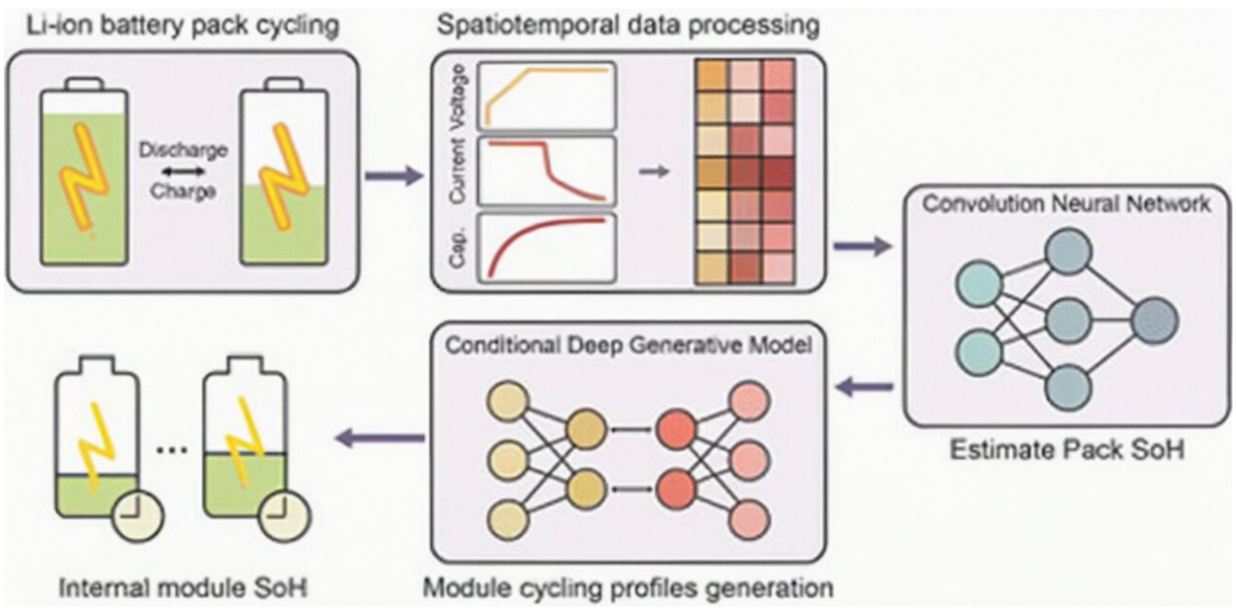

Grpahical abstract. Credit: *Journal of Materials Chemistry A* (2023). DOI: 10.1039/D3TA03603K

As the electric vehicle market continues to surge, the assessment of used batteries has become increasingly crucial. A team of researchers, led by Professor Donghyuk Kim and Professor Yunseok Choi in the School of Energy and Chemical Engineering at UNIST, along with Professor Hankwon Lim of the Graduate School of Carbon Neutrality at UNIST, has developed DeepSUGAR to help with this challenge.

This advanced deep learning-based framework offers a novel approach to estimating the State-of-Health (SoH) of exhausted batteries, improving efficiency and reducing power consumption.

The study findings have been published in the online version of *Journal of Materials Chemistry A*.

Current assessment technologies for used batteries involve separate estimation of the SoH of the battery pack and its individual modules, leading to time inefficiency and excessive power consumption. DeepSUGAR addresses these challenges by utilizing a generative algorithm based on graphical representation techniques, enabling the estimation of individual module health based on battery pack SoH.

The research team analyzed the cycling profiles of a 14S7P pack and its constituent modules, training a convolutional neural network (CNN) to estimate SoH by spatializing cycling curves. DeepSUGAR, trained on pack data, exhibited outstanding performance with a Root Mean Square Error (RMSE) of 5.31×10^{-3}. Validation testing with module data resulted in an RMSE of 7.38×10^{-3}, further confirming its applicability. Additionally, the generated module cycling profiles from pack SoH using the deep generative model demonstrated remarkable performance with an RMSE of 8.38×10^{-3}.

DeepSUGAR offers several key advantages, including reduced power consumption, processing costs, and carbon dioxide emissions, by integrating module-level diagnosis within the pack-level assessment process. This breakthrough technology has the potential to significantly impact battery health management, as it can diagnose the health status of exhausted batteries without being limited by the type of device.

"We have established a verification system that can determine whether a used battery is recyclable without disassembling the battery," explained

Professor Donghyuk Kim. "DeepSUGAR images charging and discharging data, enabling the determination of the health condition of the battery."

DeepSUGAR's capabilities extend beyond battery recycling. By predicting the health status of internal modules through pack diagnosis, this technology has the potential to optimize battery performance in various applications, contributing to the realization of green energy in the future.

More information: Seojoung Park et al, A deep learning-based framework for battery reusability verification: one-step state-of-health estimation of pack and constituent modules using a generative algorithm and graphical representation, *Journal of Materials Chemistry A* (2023). DOI: 10.1039/D3TA03603K

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